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UTILITY  
PATENT APPLICATION  
TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 10960502-7 Total Pages 31

First Named Inventor or Application Identifier

ABDOLREZA MOVAGHAR

Express Mail Label No. EH621591830

## APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231

1. ☒ Fee Transmittal Form  
(Submit an original, and a duplicate for fee processing)
2. ☒ Specification [Total Pages 21] 1  
(preferred arrangement set forth below)
- Descriptive title of the Invention
  - Cross References to Related Applications
  - Statement Regarding Fed sponsored R & D
  - Reference to Microfiche Appendix
  - Background of the Invention
  - Brief Summary of the Invention
  - Brief Description of the Drawings (if filed)
  - Detailed Description
  - Claim(s)
  - Abstract of the Disclosure
3. ☒ Drawing(s) (35 USC 113) [Total Sheets 6] 1
4. Oath or Declaration [Total Pages 2] 1
- a. ☐ Newly executed (original or copy)
  - b. ☒ Copy from a prior application (37 CFR 1.63(d))  
(for continuation/divisional with Box 17 completed)  
[Note Box 5 below]
  - i. ☐ DELETION OF INVENTOR(S)  
Signed statement attached deleting  
inventor(s) named in the prior application,  
see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☒ Incorporation By Reference (useable if Box 4b is checked)  
The entire disclosure of the prior application, from which a  
copy of the oath or declaration is supplied under Box 4b,  
is considered as being part of the disclosure of the  
accompanying application and is hereby incorporated by  
reference therein.

6. ☐ Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission  
(if applicable, all necessary)
- a. ☐ Computer Readable Copy
  - b. ☐ Paper Copy (identical to computer copy)
  - c. ☐ Statement verifying identity of above copies

## ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney  
(when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure ☐ Copies of IDS  
Statement (IDS)/PTO-1449 Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)  
(Should be specifically itemized)
14. ☐ Small Entity ☐ Statement filed in prior application,  
Statement(s) Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)  
(if foreign priority is claimed)
16. ☐ Other: .....

## 17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☒ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: 08 / 701,619

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ADDRESS

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PO BOX 10301

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PALO ALTO

STATE

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<b>FEE TRANSMITTAL</b>  <i>Note: Effective October 1, 1997. Patent fees are subject to annual revision.</i>	<b>Complete if Known</b>	
	Application Number	
	Filing Date	
	First Named Inventor	ABDOLREZA MOVAGHAR
	Group Art Unit	
	Examiner Name	
TOTAL AMOUNT OF PAYMENT (\$)	856.00	Attorney Docket Number 10960502-7

<b>METHOD OF PAYMENT (check one)</b>  1. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge indicated fees and credit any over payments to: Deposit Account Number <u>08-2025</u> Deposit Account Name <u>HEWLETT-PACKARD CO.</u> <input checked="" type="checkbox"/> Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17 <input type="checkbox"/> Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance  2. <input type="checkbox"/> Payment Enclosed: <input type="checkbox"/> Check <input type="checkbox"/> Money Order <input type="checkbox"/> Other	<b>FEE CALCULATION (continued)</b>  <b>3. ADDITIONAL FEES</b> <table border="1"><thead><tr><th>Large Entity Fee Code (\$)</th><th>Small Entity Fee Code (\$)</th><th>Fee Description</th><th>Fee Paid</th></tr></thead><tbody><tr><td>105 130</td><td>205 65</td><td>Surcharge - late filing fee or oath</td><td></td></tr><tr><td>127 50</td><td>227 25</td><td>Surcharge - late provisional filing fee or cover sheet.</td><td></td></tr><tr><td>139 130</td><td>139 130</td><td>Non-English specification</td><td></td></tr><tr><td>147 2,520</td><td>147 2,520</td><td>For filing a request for reexamination</td><td></td></tr><tr><td>112 920*</td><td>112 920*</td><td>Requesting publication of SIR prior to Examiner action</td><td></td></tr><tr><td>113 1,840*</td><td>113 1,840*</td><td>Requesting publication of SIR after Examiner action</td><td></td></tr><tr><td>115 110</td><td>215 55</td><td>Extension for reply within first month</td><td></td></tr><tr><td>116 400</td><td>216 200</td><td>Extension for reply within second month</td><td></td></tr><tr><td>117 950</td><td>217 475</td><td>Extension for reply within third month</td><td></td></tr><tr><td>118 1,510</td><td>218 755</td><td>Extension for reply within fourth month</td><td></td></tr><tr><td>128 2,060</td><td>228 1,030</td><td>Extension for reply within fifth month</td><td></td></tr><tr><td>119 310</td><td>219 155</td><td>Notice of Appeal</td><td></td></tr><tr><td>120 310</td><td>220 155</td><td>Filing a brief in support of an appeal</td><td></td></tr><tr><td>121 270</td><td>221 135</td><td>Request for oral hearing</td><td></td></tr><tr><td>138 1,510</td><td>138 1,510</td><td>Petition to institute a public use proceeding</td><td></td></tr><tr><td>140 110</td><td>240 55</td><td>Petition to revive - unavoidable</td><td></td></tr><tr><td>141 1,320</td><td>241 660</td><td>Petition to revive - unintentional</td><td></td></tr><tr><td>142 1,320</td><td>242 660</td><td>Utility issue fee (or reissue)</td><td></td></tr><tr><td>143 450</td><td>243 225</td><td>Design issue fee</td><td></td></tr><tr><td>144 670</td><td>244 335</td><td>Plant issue fee</td><td></td></tr><tr><td>122 130</td><td>122 130</td><td>Petitions to the Commissioner</td><td></td></tr><tr><td>123 50</td><td>123 50</td><td>Petitions related to provisional applications</td><td></td></tr><tr><td>126 240</td><td>126 240</td><td>Submission of Information Disclosure Stmt</td><td></td></tr><tr><td>581 40</td><td>581 40</td><td>Recording each patent assignment per property (times number of properties)</td><td></td></tr><tr><td>146 790</td><td>246 395</td><td>Filing a submission after final rejection (37 CFR 1.129(a))</td><td></td></tr><tr><td>149 790</td><td>249 395</td><td>For each additional invention to be examined (37 CFR 1.129(b))</td><td></td></tr><tr><td colspan="3">Other fee (specify) _____</td><td></td></tr><tr><td colspan="3">Other fee (specify) _____</td><td></td></tr><tr><td colspan="3">SUBTOTAL (3) (\$)</td><td>0</td></tr></tbody></table>	Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid	105 130	205 65	Surcharge - late filing fee or oath		127 50	227 25	Surcharge - late provisional filing fee or cover sheet.		139 130	139 130	Non-English specification		147 2,520	147 2,520	For filing a request for reexamination		112 920*	112 920*	Requesting publication of SIR prior to Examiner action		113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action		115 110	215 55	Extension for reply within first month		116 400	216 200	Extension for reply within second month		117 950	217 475	Extension for reply within third month		118 1,510	218 755	Extension for reply within fourth month		128 2,060	228 1,030	Extension for reply within fifth month		119 310	219 155	Notice of Appeal		120 310	220 155	Filing a brief in support of an appeal		121 270	221 135	Request for oral hearing		138 1,510	138 1,510	Petition to institute a public use proceeding		140 110	240 55	Petition to revive - unavoidable		141 1,320	241 660	Petition to revive - unintentional		142 1,320	242 660	Utility issue fee (or reissue)		143 450	243 225	Design issue fee		144 670	244 335	Plant issue fee		122 130	122 130	Petitions to the Commissioner		123 50	123 50	Petitions related to provisional applications		126 240	126 240	Submission of Information Disclosure Stmt		581 40	581 40	Recording each patent assignment per property (times number of properties)		146 790	246 395	Filing a submission after final rejection (37 CFR 1.129(a))		149 790	249 395	For each additional invention to be examined (37 CFR 1.129(b))		Other fee (specify) _____				Other fee (specify) _____				SUBTOTAL (3) (\$)			0
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<b>SUBMITTED BY</b>		<b>Complete (if applicable)</b>	
Typed or Printed Name	LARRY K. ROBERTS	Reg. Number	28,464
Signature	<i>Larry K Roberts</i>	Date	1/20/98
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EH621591830US

PATENT  
10960502-1

APPARATUS FOR SECURING CCD BOARD AT A  
FIXED POSITION WITHIN A RANGE OF MOTION

Abdolreza Movaghar  
Josephine del Rosario  
Mark Diel  
David J. Schmeling

APPARATUS FOR SECURING CCD BOARD AT A FIXED POSITION  
WITHIN A RANGE OF MOTION

CROSS-REFERENCE TO RELATED APPLICATION

5 This is a continuation of application serial number  
08/701,619, filed August 22, 1996.

TECHNICAL FIELD OF THE INVENTION

10 This invention relates to the field of optical sys-  
tems, and more particularly to optical systems employing  
optical sensors which require alignment for proper opera-  
tion of the system.

BACKGROUND OF THE INVENTION

15  
20  
25  
Optical systems such as optical scanner devices for  
scanning a recorded image to produce a representative image  
use optical sensor arrays such as charged coupled device  
(CCD) arrays. The CCD array is situated relative to the  
recorded image such that the recorded image and CCD array  
move relative to each other, wherein the recorded image  
moves in relation to the optical sensor array. The sensor  
array converts the image into electrical signals represen-  
tative of image pixels comprising the image. Typical of  
these optical scanner devices are multiple function  
machines which include the functions of a printer, facsimi-

le machine, photocopy machine and/or optical scanner device within one machine.

5 In order to achieve optimal scanning quality, the optical sensor and the optical system need to be aligned, positioned and fixed in space relative to each other. For a single line CCD, five degrees of freedom (DOF) out of six DOF are essential to this alignment. The majority of scanners on the market today have active control of only four DOF; movement along the x and z axis and rotation about the y axis are controlled on the CCD device, and movement along the y axis is controlled on the lens. Consequently these scanners have very small tolerances in the rotational z direction. The typical securing method is to tighten down two screws which hold the CCD relative to the optical path. This tightening process imparts torques and forces to the CCD which move it from the optimum aligned position. Also, moving the lens in the y direction degrades the optimum alignment because (i) the optical axis is typically not parallel to the axis of movement, and (ii) mechanical imperfections in the lens and/or housing cause undesired movement in the other axes during movement in the y direction.

20 It would therefore be an improvement in the art to provide an optical sensor system with improved alignment capabilities, wherein the optical sensor can be aligned without causing forces moving the sensor from the optimum aligned position.

#### SUMMARY OF THE INVENTION

30 In accordance with an aspect of the invention, apparatus is described for securing an optical apparatus at a fixed relative location within a range of motion. The apparatus includes a first housing member holding the optical apparatus, and a first bracket member fabricated of

a UV transparent material. The apparatus further includes a compliant apparatus for holding the first housing member and the first bracket member loosely together, while permitting relative motion between the first housing and the first bracket member through a range of motion. A curable bonding element applied between areas of the first housing member and the first bracket member bonds the first housing member and the first bracket member together in a fixed position within the range of movement. The bonding element is applied while in a liquid state to permit the relative motion, and includes an adhesive which is cured to a solid state by exposure to ultraviolet light. The first housing member and the first bracket member are fixed in the relative position by the curing of the adhesive to a solid state.

A preferred application for the invention is in an optical scanner device, wherein the optical sensor array is moveable through a range of motion relative to a scanner housing, and then fixed in a desired location within the range of motion by use of the curable element.

#### BRIEF DESCRIPTION OF THE DRAWING

These and other features and advantages of the present invention will become more apparent from the following detailed description of an exemplary embodiment thereof, as illustrated in the accompanying drawings, in which:

FIG. 1 is a simplified side view of a multiple function machine employing the invention.

FIG. 2 is an isometric view of an optical scanner apparatus embodying the invention.

FIG. 3 is an exploded view of the scanner housing, middle bracket, optical sensor housing and optical sensor board of the apparatus of FIG. 2.

FIG. 4 is a cross-sectional view taken along line 4-4 of FIG. 2.

FIG. 5 is a cross-sectional view taken along line 5-5 of FIG. 4.

5        FIG. 6 is a cross-sectional view taken along line 6-6 of FIG. 4.

FIG. 7 is a cross-sectional view taken along line 7-7 of FIG. 4.

10       FIG. 8 illustrates a portion of the assembly of FIG. 4 at the left end thereof after applying and curing of the adhesive.

FIG. 9 is a cross-sectional view similar to FIG. 7, but illustrating the adhesive filling the adhesive cavities adjacent the left end of the assembly of FIG. 4.

15       FIG. 10 is a close-up partial isometric view of a portion of the scanner assembly of FIG. 2 after application and curing of the adhesive.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

20       FIG. 1 is a simplified side view of an exemplary apparatus employing this invention. This apparatus is a multiple-function device 20 of the type described in commonly assigned U.S. Patent 5,391,009, the entire contents of which are incorporated herein by this reference.

25       The device 20 performs functions such as optically scanning imagery from a printed sheet 10 fed through a feed path from an automatic document feeder 22 to a scanner station 30, or printing imagery onto a sheet fed from a sheet

30       feeder 24 and fed through a feed path to a printing station 40, wherein printing is performed via ink-jet cartridge 42, mounted on a traversing carriage (not shown) for movement transverse to the feed path. This invention is concerned with the optical scanner apparatus comprising the device

35       20.

The scanning station 30 includes a scanner assembly 50 which includes a light source for illuminating the surface of the document 10 to be optically scanned, the light reflected from the document surface through a light path indicated by line 52 which is folded by mirrors 52, 54 and 56 and directed through a lens 58 for focusing onto a linear optical sensor array 60, attached to a printed circuit assembly board 62. In this exemplary embodiment, the sensor array 60 comprises a linear charge coupled device (CCD) array. As is known in the optical scanner art, the document 10 is sequentially advanced through the scanner station in incremental steps, with the array 60 capturing thin lines or areas of the document surface in electrical signal form, e.g as a line of pixels having pixel values. The device includes a processor (not shown) for assembling the successive lines of pixels into an image of the scanned document surface.

To optimize the scanning performance of the optical scanner station 30, the sensor array 60 is typically optically aligned with respect to the image projected through the lens 58, and then secured in place. This invention concerns a technique by which the sensor array is fixed in position within a range of movement.

The optical apparatus in accordance with this invention provides active control over five DOF during the securing process. All five DOF (x, y, z, and rotational z and y) are controlled on the CCD array 60 without any movement of the lens 58. The lens can be secured prior to alignment and fixing in position of the CCD array, and is preferably not moved during the CCD array alignment and subsequent securing process. Securing of the CCD array is done through a gimbal design in a CCD housing and middle bracket which creates the five DOF required. There are no screws involved in the securing process to impart torques or forces to the parts. An ultraviolet (UV) activated



adhesive is used to secure the CCD housing to the middle bracket and the middle bracket to the optical scanner housing. The middle bracket is clear, and a high percentage of the UV light can pass through it to cure the adhesive applied between the two parts. A vertical hole runs through tabs of both the CCD housing and the middle bracket. The adhesive is applied into this region where it is constrained by the parts. The adhesive is a liquid during the alignment process which allows relative motion between the parts. When the parts have been moved to the proper position within the range of motion, the adhesive region is exposed to UV light which cures the adhesive into a solid vertical column, creating a form of chemical rivet. This chemical rivet provides a very strong mechanical interlock of the components in addition to the adhesive bonding of the components.

FIG. 2 is an isometric view of the scanner assembly 50, which includes a housing 70 fabricated of a molded opaque rigid plastic material, with a transparent window installed at the scanner zone through which the document to be scanned is passed. A linear light source such as a row of LEDs (not shown) is placed below the window inside the housing. The CCD array 60 (not visible in FIG. 2) is installed on the CCD printed circuit assembly board 62.

FIG. 3 is an exploded view of elements securing the CCD printed circuit assembly board 62 to the scanner housing 70. The CCD array 60 (not visible in FIG. 3) is secured to the board 62 by a conventional connector, not visible in FIG. 3, and thus is fixed in position relative to the board 62. Electrical signals from the CCD array are carried from the board 62 to the device processor via a ribbon cable, also not shown.

The CCD printed assembly board 62 is secured to a CCD housing 80 by threaded fasteners 64A and 64B which are received in bores 82A and 82B. In this exemplary embodi-

ment, the CCD housing is fabricated of an opaque rigid plastic material, e.g. a polycarbonate modified with 20% glass fibers, and is formed to define a generally rectilinear interior enclosed area 84 which receives the CCD array 60 and forms an opaque structure around the structure 60. The housing 80 has a window opening 86 formed in wall 86A through which image light passes from the lens 58 to the CCD array 60. Thus, the position of the CCD array 60 is rigidly fixed in relation to the CCD housing 80. The housing 80 further includes protruding tabs which extend generally along a center axis of the elongated housing 80, and have formed therein openings 90A and 90B which receive UV-cured adhesive, as will be described in further detail. The tabs further have protruding ears 92A and 92B.

The scanner assembly 50 further includes a middle bracket 100 which is fabricated of a material which is substantially transparent to UV light. An exemplary material suitable for the purpose is a clear plastic material such as polycarbonate. One exemplary commercially available polycarbonate is LEXAN (TM), 3412-739, marketed by General Electric Company. The bracket 100 includes several features, including attachment clip elements 102A and 102B for loosely affixing the bracket 100 to the scanner housing 70. The scanner housing 70 includes a flat wall 72 which defines a generally planar surface 74 against which a corresponding generally planar surface 104 abuts. The wall has an opening 76 (FIG. 4) formed therein as a window to permit image light to pass from the lens 58 therethrough. The upper corners of the wall 72 are notched away to provide respective areas which receive the clip elements 102A and 102B, respectively. The material from which the middle bracket 100 is formed is a resilient material, so that the clips are biased away from a rest position when the clips are positioned in place relative to the wall 72, in the manner illustrated in FIG. 2. The

position of the middle bracket 100 relative to the wall 70 can be slidably changed within in a range of movement in a plane essentially transverse to the optical axis 58A of the lens 58, until the adhesive is applied and cured. This movement is along the X and Y axes, and is represented by arrows 122 and 130 (FIG. 3). Moreover, the clips 102A and 102B permit rotational (skew) movement about the Y axis, as represented by arrows 124A and 124B.

The middle bracket 100 further includes a window 112 defined through the wall 114 which aligns with the window 86 formed in the CCD housing to permit image light to pass therethrough from the lens to the window 86.

The middle bracket 100 further includes a compliance apparatus for holding the middle bracket and the CCD housing member 80 loosely together while permitting relative motion between these two elements within a range of motion. The compliance apparatus includes four flexible, curved fingers 106A-106D which are integrally formed with the bracket. The fingers 106A-106B have respective ends integrally attached to a post section 108 defined in the wall 104 and which extends generally transversely to the elongate axis 114 of the middle bracket. Similarly the fingers 106C and 106D have respective ends integrally attached to a post section 110 defined in the wall 104 and extending generally transversely to the elongate axis 114. The tip of each finger curves inwardly away from the wall 104. The finger tips each contact the outward surface of the wall 86A of the CCD housing when the housing and bracket 100 are brought together. Since the fingers are formed in the curved position illustrated in FIG. 3, yet are flexible and tend to spring back to this position, the flexible fingers provide a gimbal with spring biasing toward a rest position.

The compliance apparatus of the middle bracket further includes pairs of spaced, aligned tabs 116A-116B and 116C-

116D which extend transversely from the wall 104. The spacing between the tabs of each pair is sufficient allow the tabs 88A and 88B of the CCD housing 80 to slide therebetween when the housing 80 and bracket are assembled together, e.g. as shown in FIG. 2. To lock the bracket 100 and housing 80 in a loosely assembled configuration, the bracket 100 further includes lugs 118A and 118B extending outboard of the tabs 116A-116D, with barb ends 120A, 120B sliding over the respective ears 92A and 92B of the housing 80. While the lugs 118A and 118B lock the elements 80 and 100 together in the loosely assembled configuration, relative movement between the elements 80 and 100 through a range of movement is not constrained by the locking action of the lugs. The range of movement includes rotational movement about the Z axis (FIG. 2) to provide a differential focus adjustment, as represented by arrow 128 (FIG. 3), and translational movement along the Y axis to provide a focus adjustment, as represented by arrow 128.

The pairs of tabs 116A-116B and 116C-116D have formed therethrough aligned hole pairs 130A-130B and 130C-130D, which receive liquid adhesive, as will be described in further detail. It is to be noted that the diameter of the holes 130A-130D is smaller than the diameter of the holes 90A-90B formed in the CCD housing 80. The holes 130A and 130C are through holes, extending through the respective tabs 116A and 116C. The holes 130B and 130D extend only partially into the respective tabs 116B and 116D, as shown in FIG. 7 (hole 116D). This is to prevent the liquid adhesive material from leaking out of the cavities defined by the holes and corresponding holes formed in the tabs 88A and 88B; one such cavity 152B is shown in FIG. 7.

FIG. 4 is a cross-sectional view of the scanner assembly 50, taken through line 4-4 of FIG. 2. In this view, the adhesive has not yet been applied, and so the CCD board 100 and middle bracket 100 are in the assembled, rest

position to which these parts have been biased by the compliance apparatus. Shown in this view is the contact made by the spring fingers 106, and the capturing by the barbed ends 120A, 120B (of lugs 118A, 118B) of the ears 92A, 92B of the CCD board 80.

FIG. 5 is a cross-sectional view taken through line 5-5 of FIG. 4, illustrating in further detail the assembled arrangement of the housing 70, CCD housing 80 and the middle bracket 100.

FIG. 6 is a close-up, enlarged view of a portion of the surface of wall 104 of the middle bracket 100 facing the scanner housing 70, and illustrating one of the adhesive-receiving features 104A, 104B formed in the wall 104. The feature 140A includes a depression 142A defined in the wall, of generally circular form, with a tapered notch 144A leading from the top edge 104A of the wall into the depression 142A. Several smaller notches 146A are defined in the edge of the depression and extend radially outwardly. The features 104A, 104B are identical.

When the bracket 100 is affixed to the scanner housing 70 by the clips 102A, 102B, the features 104A, 104B are adjacent adhesive-receiving features 78A, 78B formed in the wall 74 of the scanner housing 70. The features 78A, 78B are, in this exemplary embodiment, T-shaped depressions formed in the wall 74. With the middle bracket 100 clipped against the wall 74, the corresponding features 78A, 140A and 78B, 140B form cavities with an open channel defined by the notches 144A, 144B leading from the top edge 104A into the cavities. Adhesive in a liquid state can be dispensed into these cavities through the channels. The interior surfaces of the cavities can be roughened to provide improved surface adhesion.

FIG. 7 is a cross-sectional view taken through line 7-7 of FIG. 4, and illustrates one cavity 150B defined by the features 140B and 78B. The two cavities 150A and 150B,

which the application and curing of an adhesive, provide a means of fixed rigidly in relative position the scanner housing 70 and the middle bracket 100.

Two other adhesive-receiving cavities are employed in the scanner assembly 50 in accordance with the invention, in order to rigidly fix the relative positions of the middle bracket 100 and the CCD housing 80. These two cavities 152A and 152B, (cavity 152B is shown in FIG. 7), with application and curing of adhesive in the cavities, provide the means of rigidly fixing the relative positions of the elements 80 and 100 at one position within the range of movement permitted by the compliance apparatus. The adhesive can be dispensed in its liquid state into the cavities 152A, 152B with the assembly in an upright position as shown in FIG. 7.

FIG. 7 shows one cavity 152B, defined by the holes 130C, 130D formed in the tabs 116C, 116D of the bracket 100, and the larger hole 90B formed in the tab 88B of the housing 80. Because the diameter of the intermediate hole 90B is larger than the diameters of the upper and lower holes 130C, 130D, the cavity 152B correspondingly has a larger diameter middle cavity portion sandwiched between smaller diameter upper and lower cavity portions. As a result, the adhesive when dispensed into the cavity 152B and cured will form a solid "rivet" or column of adhesive material that is locked in place by the surrounding edges of the tabs 88B, 116C and 116D. Since the hole 130D is not a through hole through tab 116D, the liquid adhesive will not run out the bottom of the cavity 152B.

FIGS. 8, 9 and 10 illustrate the cavities after the adhesive has been dispensed into the cavities 150B and 152B and cured into a hard material. Adhesive plug 160B fills the cavity 150B, and adheres to the cavity surfaces defined by the features 78B and 140B, and in combination with the adhesive plug 160A filling the cavity 150A, fixes the

middle bracket 100 to the housing 70. Adhesive plug 162B fills the cavity 152B, and in combination with the adhesive plug 16A filling cavity 152A, fixes the CCD housing and middle bracket 100 rigidly together in a fixed position within the range of movement permitted by the compliance apparatus.

The adhesive dispensed into the cavities 150A, 150B and 152A, 152B is, in this exemplary embodiment, an adhesive which is a liquid when in an uncured state, and is cured by application of ultraviolet (UV) light to a solid state. Thus, the parts 70, 80 and 100 will be assembled loosely together by use of the clips 102A, 102B, and the locking lugs 118A, 118B to a rest position. The adhesive in its liquid, uncured state is dispensed into the cavities 150A, 150B, 152A, 152B. The CCD board 80 can then be moved within the range of movement permitted by the compliance apparatus, and the bracket 100 can be moved within the range of movement permitted by the clips 102A, 102B, until a desired position of the CCD board and the middle bracket is reached. Preferably this position is one at which the array 60 is aligned with the image light from the lens 58, but this invention permits the elements 70, 80 and 100 to be locked in any position within the range of movement, without the use of threaded fasteners. With the elements 70, 80 and 100 held in the desired position, e.g. in a fixture, the assembly is illuminated with UV light. Because the middle bracket 100 is fabricated of a material which is transparent to UV light, the adhesive in the cavities will be exposed to the UV light and cured to a solid state. The parts are then fixed at the desired position.

Adhesives suitable for this purpose are commercially available. One such adhesive is available from the Loctit Corporation, as adhesive 3321, part no. 19739. The adhe-

sive can be cured to a solid state with an exposure time in the range of tens of seconds.

5 It is understood that the above-described embodiments are merely illustrative of the possible specific embodiments which may represent principles of the present invention. Other arrangements may readily be devised in accordance with these principles by those skilled in the art without departing from the scope and spirit of the invention.



CLAIMSWhat is claimed is:

1. Apparatus for securing an optical apparatus at a fixed relative location within a range of motion, comprising:

5 a first housing member holding the optical apparatus;

a first bracket member;

10 compliant apparatus for holding the first housing member and the first bracket member loosely together, while permitting relative motion between the first housing and the first bracket member through a range of motion;

15 a curable fixing element applied between areas of the first housing member and the first bracket member for securing the first housing member and the first bracket member together in a fixed position within the range of movement, the fixing element applied while in a liquid state to permit said relative motion, said fixing element curable to a solid state during a curing process, wherein the first housing member and  
20 said first bracket member are fixed in said relative position.

2. The apparatus of Claim 1 wherein said curing process comprises the application of light at a predetermined spectral range to said fixing element.

3. The apparatus of Claim 2 wherein said first bracket member includes structural portions which are transparent to said light of said predetermined spectral range.

4. The apparatus of Claim 2 wherein said predetermined spectral range is the ultraviolet range.

5 5. The apparatus of Claim 1, wherein the compliant apparatus comprises a first set of interlock elements on said middle bracket and a second set of interlock elements on said housing, wherein said first and second sets are interlocking to hold said bracket and housing loosely together.

5 6. The apparatus of Claim 5 wherein said first set of interlocking elements includes a lug element having a barbed end, and said second set of interlocking elements includes a protruding ear portion, said barbed end of said lug element engagable over said protruding ear portion to provide said interlocking.

7. The apparatus of Claim 1 wherein said complaint apparatus further includes a biasing structure for biasing the relative position of said first housing and said first bracket to a rest position within said range of motion.

8. The apparatus of Claim 7 wherein said biasing structure comprises a plurality of resilient finger elements extending from said middle bracket and contacting a surface of said housing.

5 9. The apparatus of Claim 1 wherein said first bracket member further comprises a first cavity defining feature, said housing member further comprises a second cavity defining feature, and wherein first and second cavity defining features cooperate together to define a first cavity for accepting said curable fixing element, and wherein said curable fixing element when cured forms an

adhesive and mechanical interlock holding said first housing and said first bracket together.

10. The apparatus of Claim 9 wherein said first cavity defining feature includes first and second spaced, aligned tab elements each having a hole defined therein, and wherein the holes are generally aligned colinearly, and  
5 said second cavity defining feature includes a third tab having a hole formed therein, and wherein said third tab is receivable between said first and second tabs such that said holes are generally aligned to form said cavity.

11. The apparatus of Claim 10 wherein said hole formed in said third tab is of larger diameter than said holes formed in said first and second tab.

12. The apparatus of Claim 1 wherein said optical apparatus includes an optical sensor.

13. Apparatus for securing an optical apparatus at a fixed relative location within a range of motion, comprising:

5 a first housing member holding the optical apparatus;

a middle bracket member;

compliant apparatus for holding the first housing member and the first bracket member loosely together, while permitting relative motion between the first  
10 housing and the first bracket member through a first range of motion;

a second housing member;

apparatus for holding said middle bracket to said second housing member while permitting relative motion  
15 between the middle bracket and said second housing member through a second range of motion;

20 a first curable fixing element applied between  
areas of the first housing member and the middle  
bracket member for securing the first housing member  
and the middle bracket member together in a fixed  
position within the range of movement, the fixing  
element applied while in a liquid state to permit said  
relative motion, said fixing element curable to a  
solid state by a curing process, wherein the first  
25 housing member and said middle bracket member are  
fixed in said relative position; and

30 a second curable fixing element applied between  
areas of said middle bracket and said second housing  
member for securing the middle bracket and said second  
housing member together in a fixed position within the  
second range of motion, the second fixing element  
applied while in a liquid state to permit said rela-  
tion motion within said second range of motion, said  
second fixing element curable to a solid state by said  
35 curing process, wherein the second housing member,  
said middle bracket and said first housing member are  
rigidly secured together in an optical assembly.

14. The apparatus of Claim 13 wherein said curing process comprises the application of light at a predetermined spectral range to said fixing element.

15. The apparatus of Claim 14 wherein said first bracket member includes structural portions which are transparent to said light of said predetermined spectral range.

16. The apparatus of Claim 14 wherein said predetermined spectral range is the ultraviolet range.

17. The apparatus of Claim 13, wherein said middle bracket member further comprises a first cavity defining feature, said second housing member further comprises a second cavity defining feature, and wherein first and second cavity defining features cooperate together to define a first cavity for accepting said second curable fixing element, and wherein said second curable fixing element when cured forms an adhesive interlock fixedly securing said first housing and said first bracket together.

18. The apparatus of Claim 13 wherein said apparatus for holding said middle bracket to said second housing member includes a plurality of clip member protruding from and integrally formed with said middle bracket.

19. The apparatus of Claim 13 wherein said middle bracket includes portions fabricated of a material transparent to said light of a predetermined spectral range.

20. An optical scanner for performing optical scanning functions, comprising:

a transparent scanning window;

an optical scanner housing, said housing securing said window and comprising optical light path defining elements to define an optical path between said window and a lens element, said lens element fixed in position relative to said scanner housing;

an optical sensor array positioned to intercept image light passing through said lens element;

apparatus for securing said optical sensor array at a fixed relative location within a range of motion relative to said scanner housing, comprising:

a sensor housing member holding the sensor array;

a middle bracket member;

compliant apparatus for holding the sensor housing member and the first bracket member loosely together, while permitting relative motion between the sensor housing and the middle bracket member through a first range of motion;

apparatus for holding said middle bracket to said scanner housing member while permitting relative motion between the middle bracket and said scanner housing member through a second range of motion;

a first curable fixing element applied between areas of the sensor housing member and the middle bracket member for securing the sensor housing member and the middle bracket member together in a fixed position within the range of movement, the first fixing element applied while in a liquid state to permit said relative motion, said first fixing element curable to a solid state by a curing process, wherein the sensor housing member and said middle bracket member are fixed in said relative position; and

a second curable fixing element applied between areas of said middle bracket and said scanner housing member for securing the middle bracket and said scanner housing member together in a fixed position within the second range of motion, the second fixing element applied while in a liquid state to permit said relation motion within said second range of motion, said second fixing element curable to a solid state by a curing process, wherein the scanner housing member with said sensor array, said middle bracket and said scanner housing member are rigidly secured together in an optical assembly.

21. The optical scanner of Claim 20 wherein said curing process comprises the application of light at a predetermined spectral range to said first and second fixing elements.

22. The optical scanner of Claim 21 wherein said first bracket member includes structural portions which are transparent to said light of said predetermined spectral range.

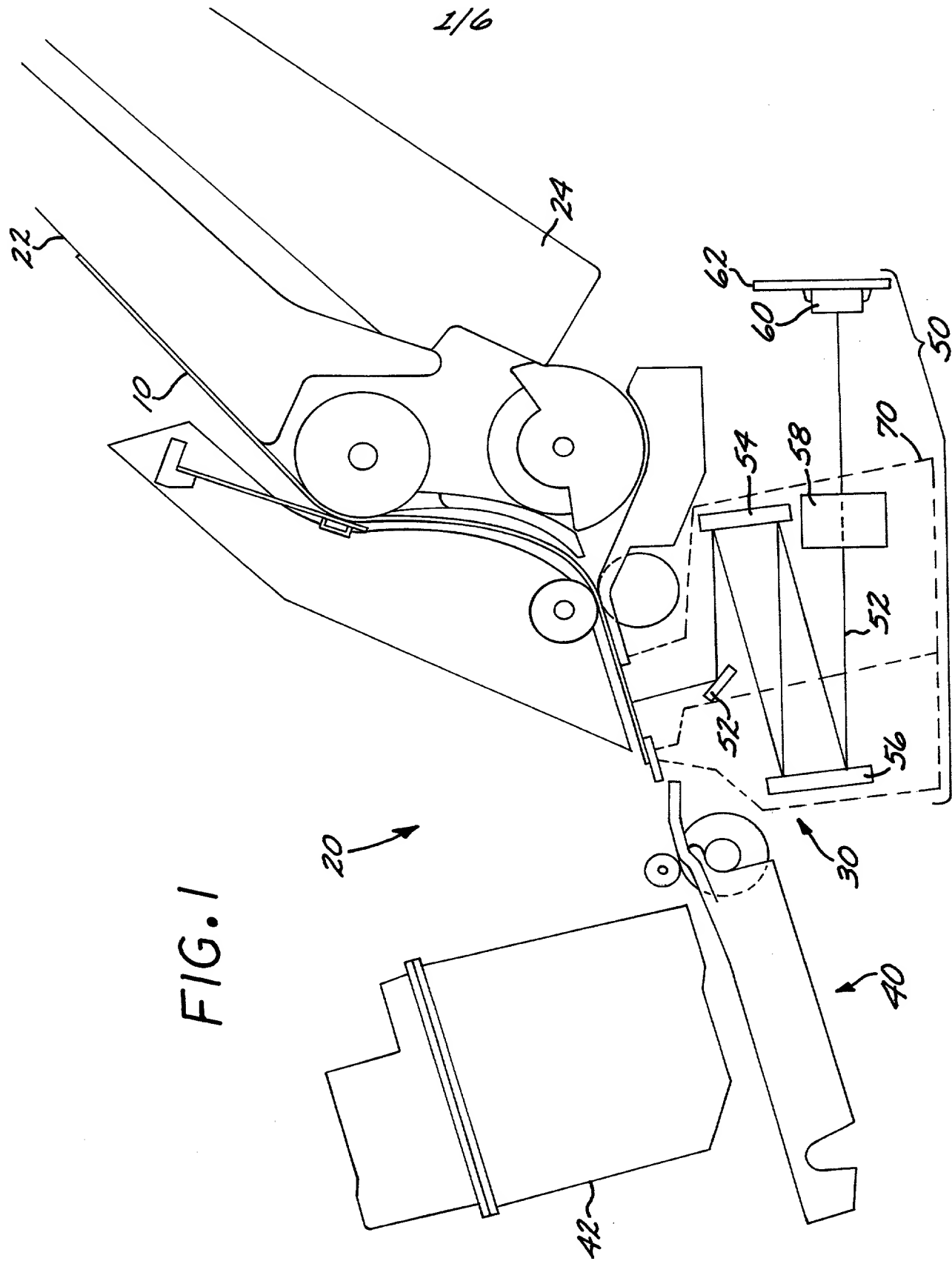
23. The apparatus of Claim 21 wherein said predetermined spectral range is the ultraviolet range.

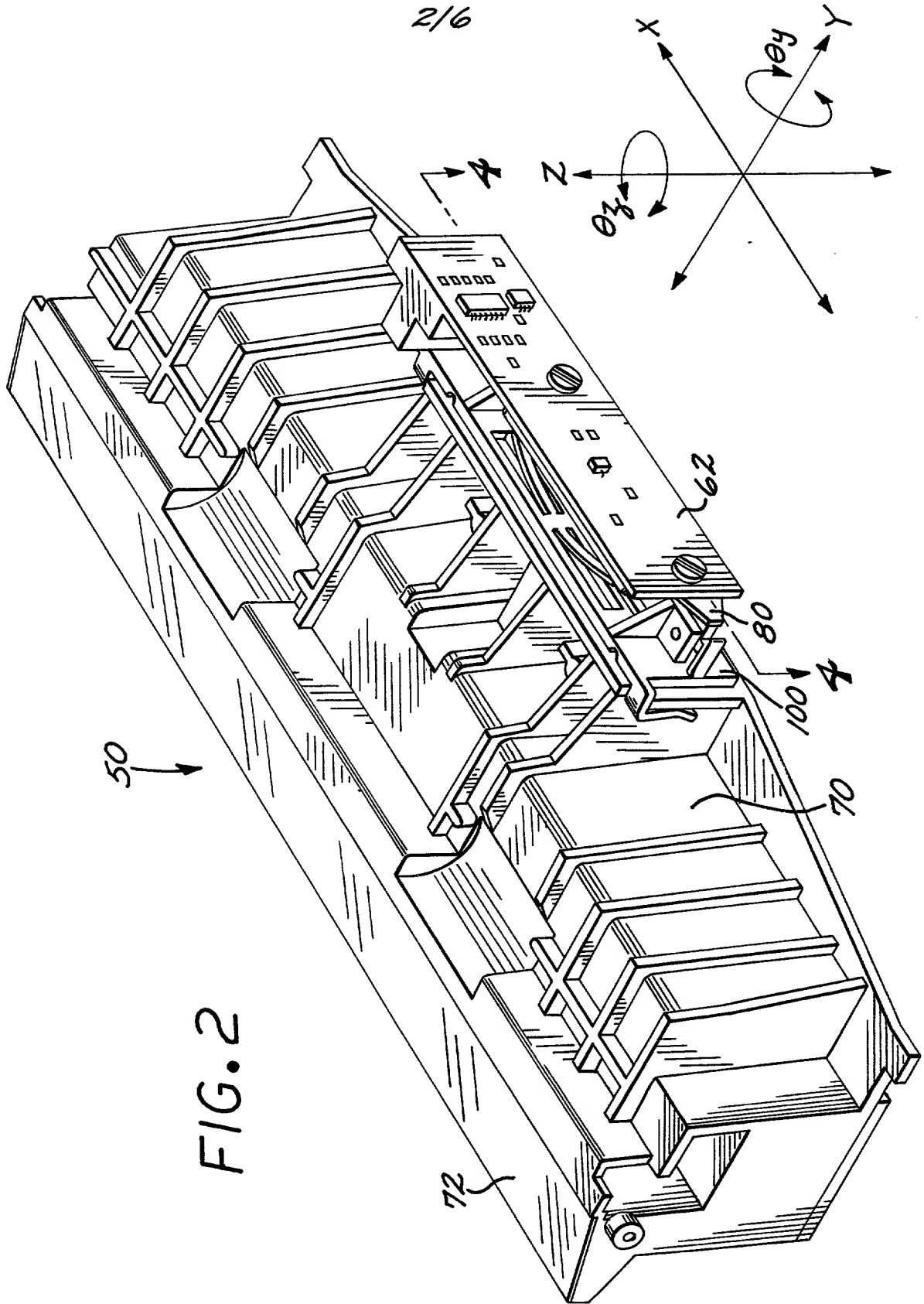
APPARATUS FOR SECURING CCD BOARD AT A FIXED POSITION  
WITHIN A RANGE OF MOTION

ABSTRACT OF THE DISCLOSURE

Apparatus for fixing the position of an optical sensor within a range of motion in relation to an optical apparatus. The fixing apparatus provides permits a range of motion through five degrees of freedom (DOF) during the securing process. The apparatus includes a housing for the optical assembly, a middle bracket, with the middle bracket secured to the optical apparatus. The range of motion is provided by a gimbal design in the housing and middle bracket which creates the five DOF. There are no screws involved in the fixing process to impart torques or forces to the parts being aligned and secured in position. An ultraviolet (UV) activated adhesive is used to secure the sensor housing to the middle bracket and the middle bracket to the optical scanner housing. The middle bracket is formed of a material transparent to UV light, and a high percentage of the UV light can pass through it to cure the adhesive applied between the parts. A vertical hole runs through tabs of both the housing and the middle bracket. The adhesive is applied into this region where it is constrained by the parts. The adhesive is a liquid during the alignment process which allows relative motion between the parts. When alignment is complete, the adhesive region is exposed to UV light which cures the adhesive into a solid vertical column, creating a form of chemical rivet. This chemical rivet provides a very strong mechanical interlock of the components in addition to the adhesive bonding of the components.







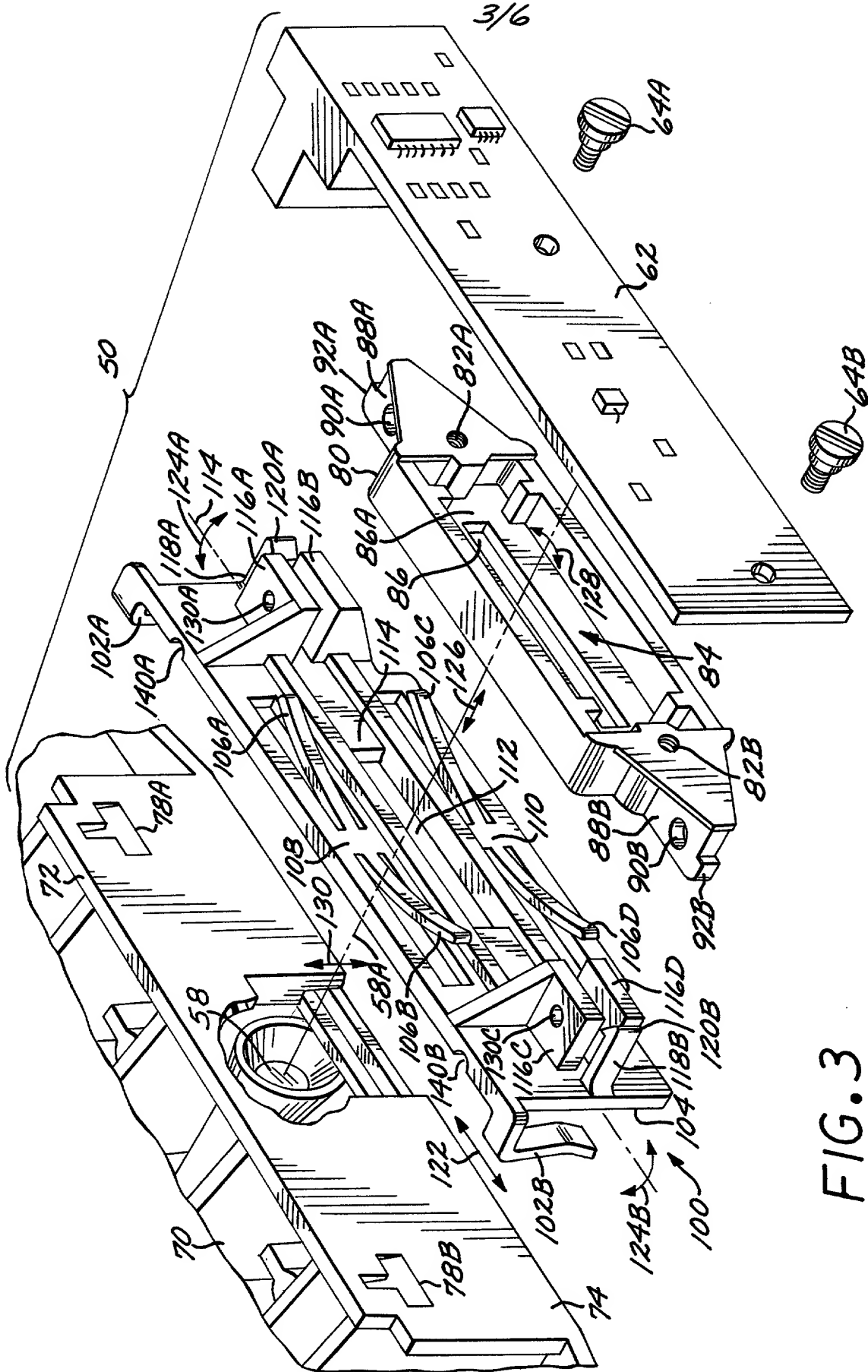


FIG. 3

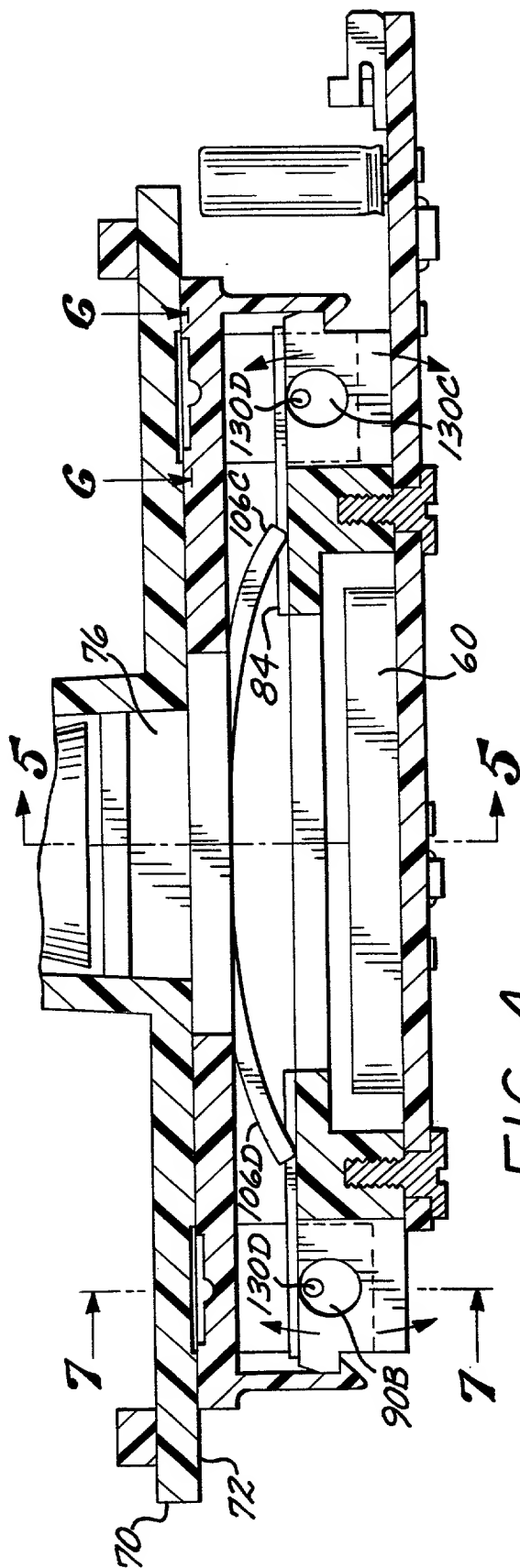


FIG. 4

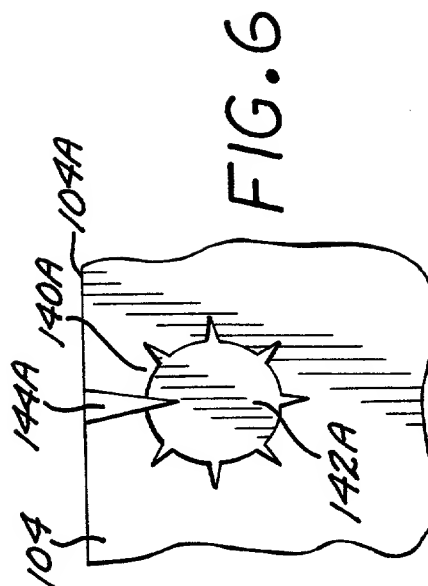


FIG. 6

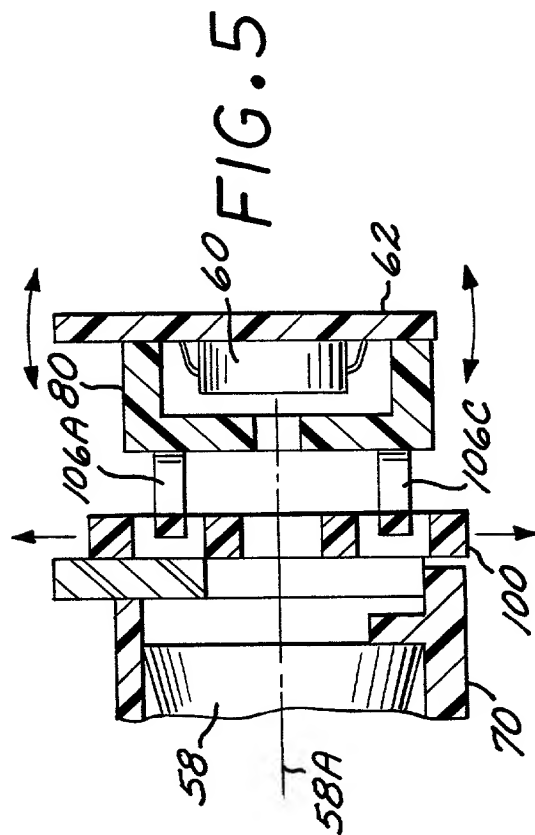


FIG. 5

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FIG. 7

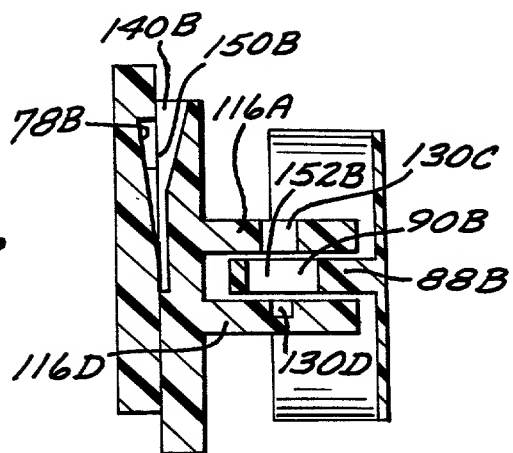


FIG. 8

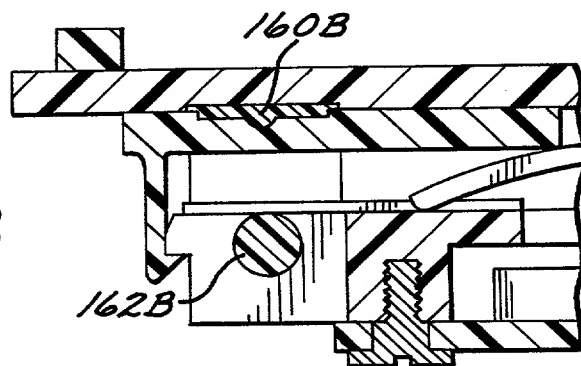
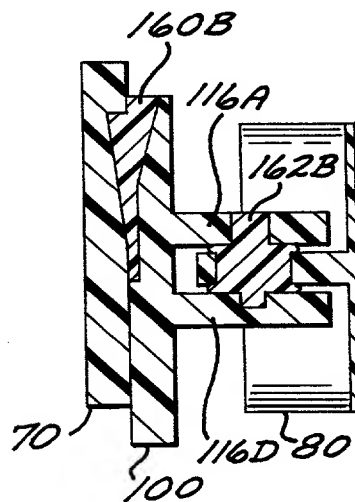


FIG. 9



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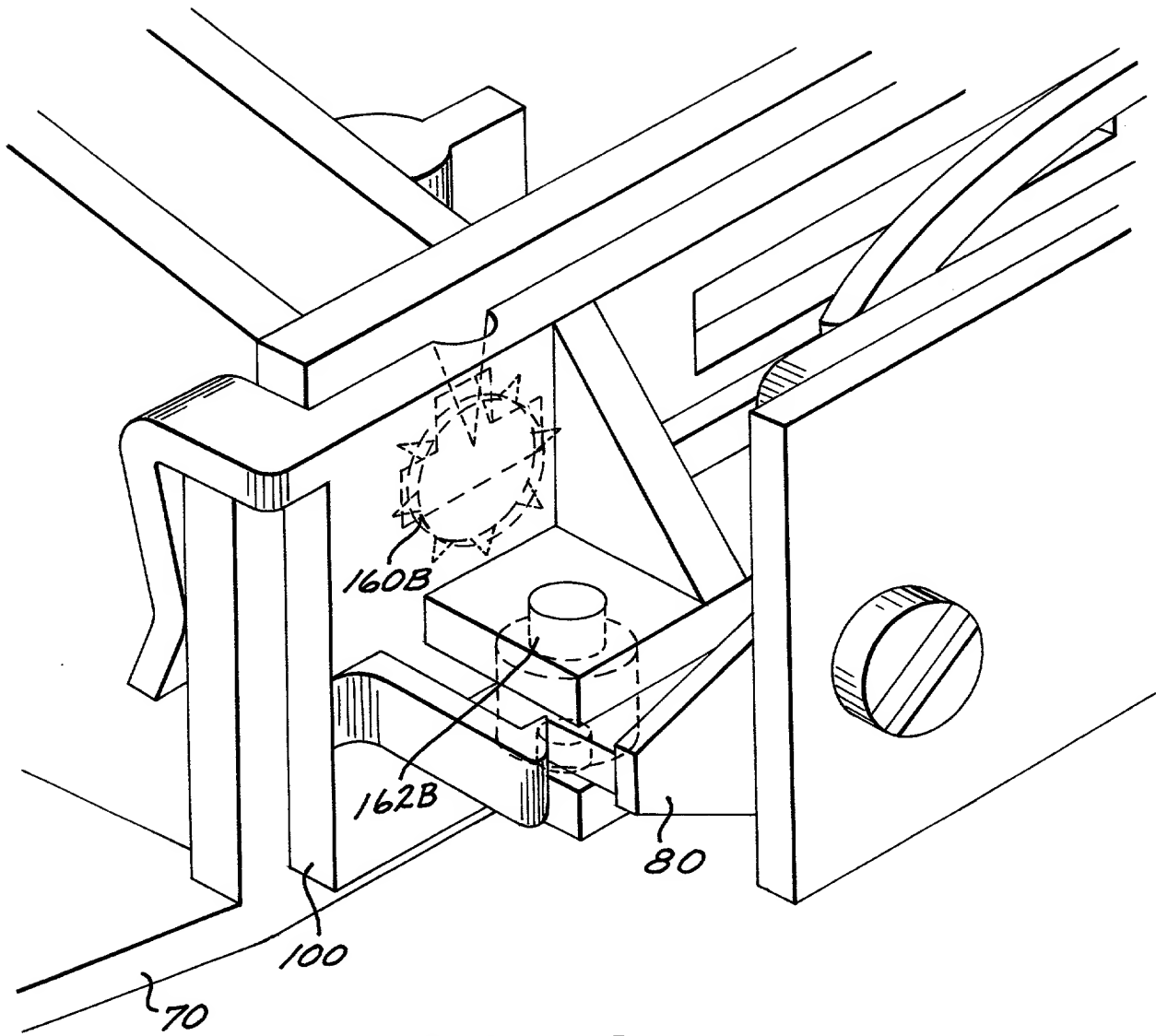


FIG. 10

DECLARATION AND POWER OF ATTORNEY  
FOR PATENT APPLICATION

ATTORNEY DOCKET NO. 10960502-1

As a below named inventor, I hereby declare that:

My residence/post office address and citizenship are as stated below next to my name:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: APPARATUS FOR SECURING CCD BOARD AT A FIXED POSITION WITHIN A RANGE OF MOTION

the specification of which is attached hereto unless the following box is checked:

( ) was filed on \_\_\_\_\_ as US Application Serial No. or PCT International Application Number \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR 1.56.

## Foreign Application(s) and/or Claim of Foreign Priority

I hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor(s) certificate listed below and have also identified below any foreign application for patent or inventor(s) certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE FILED	PRIORITY CLAIMED UNDER 35 U.S.C. 119
None			YES: _____ NO: _____
			YES: _____ NO: _____

## Provisional Application

I hereby claim the benefit under Title 35, United States Code Section 119(e) of any United States provisional application(s) lists below:

APPLICATION SERIAL NUMBER	FILING DATE

## U. S. Priority Claim

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NUMBER	FILING DATE	STATUS (patented/pending/abandoned)

## POWER OF ATTORNEY:

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) listed below to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Roland I. Griffin   David S. Romney   Dennis G. Stenstrom   Edward H. Maker, II   Larry K. Roberts  
Reg. No. 23,035   Reg. No. 24,266   Reg. No. 28,910   Reg. No. 26,762   Reg. No. 28,464

Send Correspondence to:  
IP Administration  
Legal Department, 2080  
HEWLETT-PACKARD COMPANY  
P.O. Box 10301  
Palo Alto, California 94303-0890

Direct Telephone Calls To:  
Larry K. Roberts  
Telephone No. (714) 640-6200

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Inventor: Abdolreza Movaghar   Citizenship: USA

Residence: San Diego, CA

Post Office Address: 12967 Percy Ct., San Diego, CA 92130

Res. K. Roberts  
Inventor's Signature

8/20/96  
Date

DECLARATION AND POWER OF ATTORNEY  
FOR PATENT APPLICATION (continued)

AT NEY DOCKET NO. 10960502-1

Full Name of # 2 joint inventor: Josephine del Rosario Citizenship: USA  
Residence: San Diego, CA  
Post Office Address: 11533 Windcrest Lane, # 140, San Diego, CA 92128  
Josephine del Rosario Date 08/20/96  
Inventor's Signature

Full Name of # 3 joint inventor: Mark Diel Citizenship: USA  
Residence: San Diego, CA  
Post Office Address: 311 Forth Ave, # 301, San Diego, CA 92101  
Mark Diel Date 8/20/96  
Inventor's Signature

Full Name of # 4 joint inventor: David J. Schmeling Citizenship: USA  
Residence: San Diego, CA  
Post Office Address: 9832 Rimpark Way, San Diego, CA 92124  
David J. Schmeling Date 8/20/96  
Inventor's Signature

Full Name of # 5 joint inventor: \_\_\_\_\_ Citizenship: \_\_\_\_\_  
Residence: \_\_\_\_\_  
Post Office Address: \_\_\_\_\_  
\_\_\_\_\_  
Inventor's Signature Date

Full Name of # 6 joint inventor: \_\_\_\_\_ Citizenship: \_\_\_\_\_  
Residence: \_\_\_\_\_  
Post Office Address: \_\_\_\_\_  
\_\_\_\_\_  
Inventor's Signature Date

Full Name of # 7 joint inventor: \_\_\_\_\_ Citizenship: \_\_\_\_\_  
Residence: \_\_\_\_\_  
Post Office Address: \_\_\_\_\_  
\_\_\_\_\_  
Inventor's Signature Date

Full Name of # 8 joint inventor: \_\_\_\_\_ Citizenship: \_\_\_\_\_  
Residence: \_\_\_\_\_  
Post Office Address: \_\_\_\_\_  
\_\_\_\_\_  
Inventor's Signature Date

(Use Next Page For Additional Inventor(s) Signature(s))

Page 2 of 2